Approaches for the analysis of wheat adaptation and abiotic stress responses in Andalusia

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Wheat is one of the most important cereal crops worldwide as a staple food. It possesses high phenotypic plasticity, due to the presence of a large, polyploid and complex genome with three homoeologous genomes (A, B and D). This success facilitates its adaptation to most agricultural conditions across temperate regions, as Mediterranean environments, where thermo-pluviometrical factors are highly erratic and unpredictable. As a consequence of these changeable conditions, drought can be a major stress which affects the growth, development and grain filling stages of wheat crops at the molecular and physiological levels. Nevertheless, the mechanisms and gene networks involved in wheat field drought stress responses, are still largely unknown. We have integrated different agronomic and genomic approaches to assess stress-responses in several wheat panels and lines, grown under field conditions in different environments of Andalusia. Physiological measures, together with hyperspectral and thermal imagery analyses, were used to determine the nutritional, photosynthetic and water status in the field. These data, when evaluated together with transcriptomic analyses, can be used to assess the molecular basis of wheat drought-responses under field conditions. As result, transcriptional changes were found related to alterations at the physiological level. At the molecular level, a complex structure for drought-responses was found, comprising the presence of gene clusters with differential expression patterns, the influence on biosynthetic pathways such as carotenoids or the implication of gene families such as dehydrins. In addition, the genome-wide association (GWAS) approach was used for the assessment of marker-trait associations (MTA) in agronomic performance and quality traits. Transcriptomic data were used to inform the candidate genes selection process. These results and approaches can be useful for current wheat breeding programs in Andalusia focused on wheat adaption to stress conditions and quality improvement.

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